Grower Summary

HNS 178

Bacterial diseases of herbaceous perennials

Annual 2011

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Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Project Number:	HNS 178
Project Title:	Bacterial diseases of herbaceous perennials
Project Leader:	Dr Steven J Roberts
Contractor:	Plant Health Solutions
Industry Representative:	Mr Bill Godfrey and Mr David Hide
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Headline

- Bacterial diseases were found on a variety of herbaceous perennial subjects and at all of the sites fully surveyed. When present, disease incidence often approached 100%, with disease severity at a level that could affect marketability.
- Bacterial disease symptoms are difficult to identify and are often easily confused with those caused by leaf nematodes.
- Several 'new' bacterial diseases have been found; these have not been previously reported in the scientific literature.

Background and expected deliverables

Bacterial diseases often cause sporadic but significant problems in a number of herbaceous subjects. There is a general lack of knowledge amongst growers about how to identify diseases caused by bacteria; and except for well known diseases with clear symptoms, the only reliable way of diagnosis is by laboratory examination and culturing, thus accurate information is difficult to obtain. The absence of correct diagnosis, often leads to the application of ineffective treatments, which are not only costly to the grower but, may be detrimental to the environment.

This project aims to benefit herbaceous growers by providing information which will assist in the identification of bacterial diseases and identify practical management strategies for their effective control. The specific objectives are:

1. Obtain accurate and reliable information on the extent of and causal agents of bacterial diseases on herbaceous perennials.
2. Evaluate currently/potentially approved bactericidal products against key diseases identified in (1).
3. Conduct a detailed investigation of epidemiology of key diseases identified in (1).
4. Produce images and text for a factsheet which will serve as an identification guide.

This report covers the first year of the project providing results of the survey of nurseries carried out as part of objective 1. These results will be used to inform and direct the work in subsequent years which will comprise trials work and detailed epidemiological investigations in years 2 and 3.

Summary of the project

Nurseries to be surveyed were selected in collaboration with the project's Industry Representatives. Each of the selected nurseries was visited once. The visits to nurseries were spread throughout the period from May to October 2010.

At seven of the nurseries visited a 'full' site survey was undertaken by walking the entire site and inspecting all herbaceous subjects/lines and stages of production for the presence of potential bacterial diseases. If, based on symptoms, the presence of bacterial disease was suspected, samples of symptomatic tissues were collected for laboratory investigation and diagnosis.

Due to time constraints, a more limited 'targeted' survey was done at three nurseries, in these cases the contact person was asked to highlight any specific known or perceived bacterial disease problems and samples were collected from these subjects.

All samples were examined under the microscope to rule out fungi or nematodes. If a bacterial pathogen was suspected, isolations were attempted on standard bacteriological media. The isolated bacteria were then sub-cultured and representative isolates characterised using standard bacteriological tests. Pathogenicity was also confirmed as and when healthy plants of the host genus/species became available.

The results are summarised in Table GS 1. Bacterial diseases were found at all of the sites that were fully surveyed. A total of some 92 samples were collected and examined in the laboratory, and around 100 bacterial isolates were characterised. Of the samples 42.4% were diagnosed as caused by bacteria, 25.0% by fungi and 5.4% by nematodes. For a significant proportion of samples (27%), no potential pathogen was isolated (NPI). In some of these cases it is possible that the cause was fungal or it could have been that the presence of secondary invaders of the tissues masked the presence of the primary bacterial pathogen. In a number of these 'NPI' cases a *Bacillus* strain resembling the strain used in the bio-pesticide Serenade ASO (*Bacillus subtilis* strain QST 713) was isolated; this could (for example when applied as a fungicide to plants) cause problems for diagnosis as it may grow more quickly than some pathogens on standard bacteriological media, and mask their presence. It was also noted that in some successful isolations the 'Serenade Bacillus' was present as well as the pathogen.

Table GS 1. Overall summary of HNS 178 survey for bacterial diseases in herbaceous perennials.

	No.	%
Nurseries visited	10*	
Samples examined/collected	92	100
Samples from which suspected or known bacterial pathogens isolated	39	42.4
Samples found to be infected with fungi (isolations not attempted)	23	25.0
Sample found to be infected with leaf nematodes (isolations not attempted)	5	5.4
NPI – samples from which isolation was attempted but no known or suspected bacterial pathogens were obtained	25	27.2

Notes: * 7 of the 10 were fully surveyed, the remaining 3 were 'directed' visits.

A more detailed summary of the diseases diagnosed as bacterial is shown in Table GS 2, and images of some of the most common diseases can be seen in Figure GS 1. Bacterial diseases were found and confirmed on Aquilegia, Delphinium, Erysimum, Geranium and Lavandula. Potential diseases were also found on Acanthus, Primula, Salvia, and Tiarella, but pathogenicity has yet to be confirmed (tests will continue over the next year). Bacteria were also isolated from lesions on Rudbeckia and Symphytum, but it is thought that these are probably 'low-grade' pathogens or secondary invaders of damaged/senescing tissue.

Some caution should be exercised in interpreting these results. The results represent a snapshot in time at each nursery. Hence the presence/absence of particular diseases or the dominance of a particular disease at any given nursery and in the survey as a whole may be an artefact of the presence or dominance of the particular host plant genus/species at the nurseries at the time they were surveyed. Nevertheless bacterial diseases were found at all of the sites that were fully surveyed. Most of the bacterial disease samples were collected from nurseries surveyed in June and July. In most cases the number of sites where a disease was found reflects the number of sites where the host species was grown/surveyed.

Most of the bacterial diseases identified had an incidence approaching 100%, and clearly they were easily spotted during the site surveys. It is possible that some bacterial diseases

were missed at some sites, where incidence was low. In most cases, disease severity was also at a level that may have affected marketability.

Following a presentation to and discussion at the HDC Herbaceous Perennials Technical Discussion Group (22 February 2011), two diseases were selected for intensive study in years 2 and 3 of the project: Erysimum leaf blight/wilt caused by *Xanthomonas* and Delphinium leaf blotch caused by *Pseudomonas.* These diseases were selected as they represent the two different pathogen genera found in the survey, there have also been reports of significant losses in previous years, and the crops they occur on also differ in production systems/timings/approaches.

Financial benefits

It is difficult to provide reliable overall estimates of the financial losses for bacterial (or indeed any disease) in herbaceous perennials, due the diversity of plant species, sales outlets, and responses of individual growers to disease problems. Bacterial disease outbreaks in individual species/batches can result in anything from 100% effective crop loss due to crop disfigurement and downgrading to nothing more than a slight loss of visual appeal on some plants. The actual financial losses and impacts reported by individual growers also vary depending on the size of the batch of plants and the relative importance of the species to the grower. Recent direct losses of up to £20,000 in a single season have been reported by individual growers for a single outbreak in a single crop.

Action points for growers

- Use the images contained within this report as aid to the identification of bacterial diseases.
- Send samples of new or unusual diseases for laboratory diagnosis to avoid wasting money/effort on the application of ineffective treatments.
- Samples for diagnosis should be collected before applying sprays.

Table GS 2 and Figure GS 1. Summary of the bacterial diseases found in herbaceous perennials during a 'survey' of ten nurseries.

Genus	Symptoms	Pathogen[1]	No sites	No samples[2]	Incidence[3]	Severity[4]	Priority[5]	Additional Comments
Acanthus	Dk leaf spots	Ps Gp 1a	1	1	100	1	M	'New' disease, path. TBC
Aquilegia	Dk leaf spots	Ps Gp 1b	2	2	75	2	H, M	'New' disease, pathogenicity confirmed
Delphinium	Dk irreg. leaf spots	Ps pv. delphinii	3	4	81	3	H, L, H	Well known bacterial disease, pathogenicity confirmed.
Erysimum	Yellow areas with blackened veins, leaf spots	Xanthomonas campestris	1	2	100	3	H	Probably a distinct pathovar. Pathogenicity confirmed.
Geranium	Dk brown/black ang. leaf spots/sectors, dieback	Xh pv. Pelargonii (?)	4	14	90	2.9	L-H, M, M, M	Two pathogen 'variants' isolated. A wide range of species and cvs. affected. Pathogenicity confirmed.
Lavandula	Brown irreg. leaf spots	Xanthomonas sp.	1	1	75	2.5	H	'New' disease. Pathogenicity confirmed.
Primula	Brown ang. leaf spots, marginal lesions	P vir, Ps Gp 1b	4	4	27	1.8	M, M, H, M	Literature not clear. Pathogenicity not confirmed (to be repeated).
Rudbeckia	Large brown lesions	P cichorii (?)	1	1	50	2	H	Low grade pathogen of damaged tissue (?)
Salvia	Dk ang. leaf spots, marginal lesions	Ps Gp 1b	4	5	100	2.7	H, L, M, M	'New' disease, path TBC
Symphytum	Brown ang. spots/larger lesions	P vir	2	2	100	3.2	L, L	Low grade pathogen of damaged tissue (?)
Tiarella	Brown leaf spots	Ps Gp 1b	3	3	83	2.7	L, M	'New' disease, path. TBC

Notes:
[1] Ps = *Pseudomonas syringae*; pv. = pathovar; Xh = *Xanthomonas hortorum*; P vir = *Pseudomonas viridiflava*.
[2] No. samples – in general samples were collected for each distinct species, or batch at a site, except when immediately adjacent.
[3] Incidence – the average proportion of plants affected.
[4] Severity – score on 1-4 scale. 1 – occasional spots, not very obvious. 2 – obvious spots, but unlikely to affect marketability. 3 – very obvious lesions, unacceptable for retail. 4 – very severe, unsaleable.
[5] Priority – priority assigned by individual growers. L = low, M = medium, H = High, L-H range means grower assigned different priorities to different species/cultivars.
'New' disease – not formally reported in the scientific literature.

Figure GS 1

Geraniums (*G.* x *oxonianum* left; *G. renardii,* centre; *G. maculatum*, right) with bacterial leaf spot caused by *Xanthomonas hortorum* pv. pelargonii. This was the most frequent and apparently widespread disease found during the survey. Symptoms were usually seen as dark brown or black angular leaf spots, sometimes surrounded by a red or yellow halo depending on host species. The pathogen also appears to move along the main veins causing larger necrotic areas or dry necrotic sectors on the leaves. Can be difficult to distinguish from nematode damage based on symptoms. Pathogenicity of representative strains has been confirmed.

Delphinium with bacterial leaf blotch caused by *Pseudomonas syringae* pv. *delphinii*. Symptoms are generally very clear as irregular black leaf spots or larger areas with a slight yellow halo. Pathogenicity of representative strains has been confirmed.

Erysimum with leaf blight caused by *Xanthomonas campestris*. The yellow or pale brown necrotic lesions are often one-sided (left) or give an impression of natural senescence (right). In hot weather infected leaves can wilt and dry rapidly. Leaf veins in the chlorotic/necrotic areas may be slightly darker. This disease has also been reported as causing problems in previous years. Pathogenicity of representative strains has been confirmed.

Aquilegia with bacterial leaf spot caused by a strain of *Pseudomonas syringae* Gp 1b. Left: natural infection. Right: following artificial inoculation. Lesions were almost black, limited by major veins, and may be surrounded by a red or yellow halo. This disease has also been reported as causing problems in previous years. Pathogenicity of representative strains has been confirmed.

A *Xanthomonas* sp. was consistently isolated from small (~5 mm) brown leaf spots on Lavandula. Can be difficult to see from the upper surface and easily over-looked. Pathogenicity has been confirmed.

Acanthus with a bacterial leaf spot from which a strain of *Pseudomonas Syringae* Gp 1a was isolated at one site (the only site at which Acanthus was being grown). This disease was also reported elsewhere during the 2010 season. Pathogenicity has not yet been confirmed.

A strain of *Pseudomonas syringae* Gp 1b was consistently isolated from dark brown irregular leaf spots on *Tiarella cordifolia.* Lesions were often surrounded by a slight red halo. Pathogencity has not yet been confirmed.

Dark brown angular leaf spots or marginal lesions were seen on Primulas at four sites. *Pseudomonas viridiflava* or *P. syringae* Gp 1b were isolated but initial pathogenicity tests have been negative.